Nile Tilapia (*Oreochromis niloticus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, April 2011
Revised, August 2014 and July 2015

Photo: Pam Fuller, USGS

1 Native Range, and Status in the United States

Native Range
From Nico et al. (2015):

"Tropical and subtropical Africa, Middle East. Widely distributed in Nile and Niger river basins and in lakes Tanganyika, Albert, Edward, and George, as well as in many smaller drainages and lakes in western and eastern Africa; also in Middle East in Yarkon River, Israel (Trewavas 1983)."

Status in the United States
From Nico et al. (2015):

"Established in Mississippi. Possibly established in a large reservoir bordering Florida and Georgia. Established locally (Alachua County) in Florida. Reported from Alabama and Arizona."

"A single fish in cold distress was taken from the Saugahatchee Creek portion of Yates Reservoir, in the Tallapoosa drainage of Mobile Basin, Lee County, Alabama, on 12 January 1986 (Hornsby, personal communication; Boschung 1992). Probably in reference to Yates Reservoir, Courtenay and Williams (1992) reported that a reservoir on the Tallapoosa River, where this species has been recorded, receives drainage from the aquaculture ponds of Auburn University. This species reportedly was being reared in fish farms in Arizona and apparently was introduced experimentally into the southern part of the state (Minckley 1973; Grabowski et al. 1984); however, the identification of those fish has come into question (Courtenay and Hensley 1979; Courtenay et al. 1984, 1986). Specific sites of introduction are not mentioned in the literature and there are no recent reports of this species in the state. The species is established in Orange Lake (Alachua County), Florida (FWC). Anglers have taken this species from Lake Seminole in the Apalachicola drainage, Seminole County, on both sides of the Florida and Georgia border, since about 1991; it is possibly established in the reservoir (Smith-Vaniz, personal communication). In 2004/2005 it was reported from Chicago Sanitary and Ship Canal at the Crawford Generation Plant, the South Fork of the South Branch of the Chicago River, and in 1999 from the North Shore Channel of the Chicago River at Dempster, Illinois (Wozniak, pers. comm.; Wasik, pers. comm.) A breeding population of Nile tilapia has inhabited Robinson Bayou in the Pascagoula River drainage, Mississippi since the late 1990s (Peterson et al. 2004). Recent collection sites include Crane Creek near Melbourne, Florida (T. Angradi, pers. comm.) and tidal bayous of Galveston Bay in Texas (J. Culbertson, pers. comm.) both in 2006, and Charles River in Boston, Massachusetts in 2007 (K. Hartel, pers. comm.). Specimens have been reported in non-specific locations in Puerto Rico (Lee et al. 1983)."

Means of Introductions in the United States

From Nico et al. (2015):

"This species was introduced for aquaculture purposes. It was introduced into open waters, likely through escape or release from fish farms."

Remarks

From Nico et al. (2015):

"A specimen taken from Lake Seminole on the Georgia side of the lake near Saunder's Slough in 1991 was originally reported as *O. aureus* (Gennings, personal communication); however, all available specimens and photographs of tilapia from that lake have thus far proven to be *O. niloticus* (Smith-Vaniz, personal communication). Although *O. niloticus* has been reported from Texas, these reports were based on erroneous identifications of other tilapia species (Hubbs 1982, cited by Muoneke 1988). Reports of this species in Arizona also may be based on a misidentification. Minckley's (1973) figure 122, labeled as "*Tilapia nilotica*," and his description of their young, more closely match *T. mariae* (Courtenay and Hensley 1979; Courtenay et al. 1984, 1986)."

"Grammer et al. (2012) found that introduced Nile tilapia in Mississippi live to ~4 years, confirming multi-year survival and establishment of this population."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2015):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus Oreochromis
Species *Oreochromis niloticus* (Linnaeus, 1758) – Nile mouthbreeder, tilapia del Nilo, Nile tilapia"

"Taxonomic Status: valid"

From Froese and Pauly (2015):

"The following subspecies were previously recognized: *Oreochromis niloticus baringoensis, Oreochromis niloticus cancellatus, Oreochromis niloticus eduardianus*, *Oreochromis niloticus filoa*, *Oreochromis niloticus niloticus, Oreochromis niloticus sugutae*, *Oreohromis niloticus tana* and *Oreohromis niloticus vulcani*."

Size, Weight, and Age Range

From Froese and Pauly (2015):

"Maturity: Lm 18.6, range 6 - 28 cm
Max length : 60.0 cm SL male/unsexed; [Eccles 1992]; max. published weight: 4.3 kg [IGFA 2001]; max. reported age: 9 years [Noakes and Balon 1982]"

Environment

From Froese and Pauly (2015):

"Freshwater; brackish; benthopelagic; potamodromous [Riede 2004]; depth range 0 - 6 m [Wudneh 1998], usually ? - 20 m [van Oijen 1995]."

Climate/Range

From Froese and Pauly (2015):

"Tropical; 14°C - 33°C [Philippart and Ruwet 1982]; 32°N - 10°N"

Distribution Outside the United States

Native

From CABI (2015b):

"Nile tilapia is a freshwater cichlid native to the Nile River basin; the south-western Middle East; the Niger, Benue, Volta and Senegal rivers, and the lakes Chad, Tanganyika, Albert, Edward, and Kivu (Trewavas, 1983; Daget et al., 1991)."

Introduced

From CABI (2015b):

"It has been introduced … into more than 50 countries on all the continents except Antarctica (Pullin et al., 1997), and is now found in virtually every country within the tropics."

Means of Introduction Outside the United States

From CABI (2015b):

"Nile tilapia has been widely introduced for aquaculture, augmentation of capture fisheries, and sport fishing (Trewavas, 1983; Welcomme, 1988)."

"Nile tilapia has repeatedly reached new areas after escaping from nearby fish farms, such as in the Middle Zambezi, Nata (Makgadikgadi/Okavango), Runde-Save, Buzi and Limpopo River systems (Schwank, 1995; van der Waal and Bills 1997; 2000; Tweddle and Wise, 2007; Weyl, 2008; Zengeya and Marshall, 2008)."

Short description

From Froese and Pauly (2015):

"Dorsal spines (total): 15 - 18; Dorsal soft rays (total): 11-13; Anal spines: 3; Anal soft rays: 9 - 11; Vertebrae: 30 - 32. Diagnosis: jaws of mature male not greatly enlarged (length of lower jaw 29-37 % of head length); genital papilla of breeding male not tessellated [Trewavas 1983]. Most distinguishing characteristic is the presence of regular vertical stripes throughout depth of caudal fin [Eccles 1992; Teugels and Thys van den Audenaerde 2003]."

Biology

From Froese and Pauly (2015):

"Occur in a wide variety of freshwater habitats like rivers, lakes, sewage canals and irrigation channels [Bailey 1994]. Mainly diurnal. Feed mainly on phytoplankton or benthic algae.

Oviparous [Breder and Rosen 1966]. Mouthbrooding by females [Trewavas 1983]. Extended temperature range 8-42 °C, natural temperature range 13.5 - 33 °C [Philippart and Ruwet 1982]."

"Sexual maturity is reached at 3-6 months depending on temperature, reaching about 30 g. Reproduction occurs only when temperatures are over 20°C. Several yearly spawnings every 30 days. Females incubate eggs inside their mouths (approximately for a week) where larvae hatch and remain until the vitellus is reabsorved. Egg size 1.5 mm, larval length at hatching 4 mm. Spawns in firm sand in water from 0.6 to 2 m deep of lakes. Males set up and defend territory which are visited by the females. Courtship lasts several hours. Eggs are shed in batches in shallow nest and fertilized by male. Each batch of eggs is picked up into oral cavity by female. Females solely involved in broodcare. Female carries up to 200 eggs in her mouth where the larvae hatch and remain until after the yolk-sac is absorbed."

Human uses

From Froese and Pauly (2015):

"Fisheries: highly commercial; aquaculture: commercial"

From CABI (2015b):

"Tilapia's major social impact is as an important source of protein in many developing countries. A second important impact is as a source of employment producing tilapia for export. In Brazil, tilapia also support the fee fishing recreational activities. One important social impact of tilapia aquaculture is the increase in household incomes from small farms and eateries associated with farms. Another impact is the benefit to women involved with tilapia farming. Hatcheries and genetic improvement programs employ many highly educated women in developing countries. These positions are especially important in locations where women with advanced degrees in biology have a difficult time finding employment commensurate with their education. Processing plants also hire large numbers of unskilled women for the processing line and skilled women for quality assurance. Finally, Nile tilapia, also known as Egyptian Mouth Breeders, are a popular aquarium fish."

Diseases

From Froese and Pauly (2015):

"Acanthogyrus Infestation, Parasitic infestations (protozoa, worms, etc.)"
"Aeromonosis, Bacterial diseases"
"Alitropus Infestation, Parasitic infestations (protozoa, worms, etc.)"
"Amplicaecum Infection (Larvae), Parasitic infestations (protozoa, worms, etc.)"
"Caligus Infestation 3, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Disease, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Infestation, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Infestation 2, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Infestation 3, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Infestation 4, Parasitic infestations (protozoa, worms, etc.)"
"Cichlidogyrus Infestation 5, Parasitic infestations (protozoa, worms, etc.)"

“Cichlidogyrus Infestation 10, Parasitic infestations (protozoa, worms, etc.)”
“Contracaecum Disease (larvae), Parasitic infestations (protozoa, worms, etc.)”
“Cristaria Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Cryptobia Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Dactylogyrus Gill Flukes Disease, Parasitic infestations (protozoa, worms, etc.)”
“Dactylosoma Infection 1, Parasitic infestations (protozoa, worms, etc.)”
“Dilepid Cestode larvae Infestation (general sp.), Parasitic infestations (protozoa, worms, etc.)”
“Edwardsiellosis, Bacterial diseases”
“Enterogyrus Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Ergasilus Disease 3, Parasitic infestations (protozoa, worms, etc.)”
“Epitheliocystis, Bacterial diseases”
“False Fungal Infection (Apiosoma sp.), Parasitic infestations (protozoa, worms, etc.)”
“False Fungal Infection (Epistylis sp.), Parasitic infestations (protozoa, worms, etc.)”
“Fish louse Infestation 1, Parasitic infestations (protozoa, worms, etc.)”
“Fish tuberculosis (FishMB), Bacterial diseases”
“Fish Tuberculosis 2, Parasitic infestations (protozoa, worms, etc.)”
“Gnathostoma Disease (larvae), Parasitic infestations (protozoa, worms, etc.)”
“Gyrodactylus Infestation 1, Parasitic infestations (protozoa, worms, etc.)”
“Gyrodactylus Infestation 2, Parasitic infestations (protozoa, worms, etc.)”
“Ichthyophthirius Disease, Parasitic infestations (protozoa, worms, etc.)”
“Iridovirosis, Viral diseases”
“Lamproglena Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Myxobacterial Infections, Bacterial diseases”
“Skin Flukes, Parasitic infestations (protozoa, worms, etc.)”
“Sporozoa-infection (Myxobolus sp.), Parasitic infestations (protozoa, worms, etc.)”
“Transversotrema Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Trichodina Infection 1, Parasitic infestations (protozoa, worms, etc.)”
“Trichodina Infection 5, Parasitic infestations (protozoa, worms, etc.)”
“Trichodina Infestation 8, Parasitic infestations (protozoa, worms, etc.)”
“Trichodina Infestation 9, Parasitic infestations (protozoa, worms, etc.)”
“Trichodina Infestation 10, Parasitic infestations (protozoa, worms, etc.)”
“Trichodinosis, Parasitic infestations (protozoa, worms, etc.)”
“Tripartiella Infestation, Parasitic infestations (protozoa, worms, etc.)”
“Tripartiella Infestation 2, Parasitic infestations (protozoa, worms, etc.)”
“Trypanosoma Infection, Parasitic infestations (protozoa, worms, etc.)”
“Trypanosoma Infestation 2, Parasitic infestations (protozoa, worms, etc.)”
“Turbidity of the Skin (Freshwater fish), Parasitic infestations (protozoa, worms, etc.)”
“Whirling Viral Disease of Tilapia Larvae, Viral diseases”
“Yellow Grub, Parasitic infestations (protozoa, worms, etc.)”

From FAO (2015):

“Disease: Motile Aeromonas Septicaemia (MAS); Agent: *Aeromonas hydrophila* & related species; Type: Bacteria; Syndrome: Loss of equilibrium; lethargic swimming; gasping at surface; haemorrhaged or inflamed fins & skin; bulging eyes; opaque corneas; swollen abdomen containing cloudy or bloody fluid; chronic with low daily mortality”

“Disease: Vibriosis; Agent: *Vibrio anguillarum* & other species; Type: Bacteria; Syndrome: Same as MAS; caused by stress & poor water quality”

“Disease: Edwardsiellosis; Agent: *Edwardsiella tarda*; Type: Bacterium; Syndrome: Few external symptoms; bloody fluid in body cavity; pale, mottled liver; swollen, dark red spleen; swollen, soft kidney”

“Disease: Streptococcosis; Agent: *Streptococcus iniae* & *Enterococcus* sp.; Type: Bacteria; Syndrome: Lethargic, erratic swimming; dark skin pigmentation; exophthalmia with opacity & haemorrhage in eye; abdominal distension; diffused haemorrhaging in operculum, around mouth, anus & base of fins; enlarged, nearly black spleen; high mortality.”

“Disease: Saprolegniosis; Agent: *Saprolegnia parasitica*; Type: Fungus; Syndrome: Lethargic swimming; white, grey or brown colonies that resemble tufts of cotton; open lesions in muscle”
“Disease: Ciliates; Agent: *Ichthyophthirius multifiliis*; *Trichodina* & others; Type: Protozoan parasite; Syndrome: Occurs on gills or skin”

“Disease: Monogenetic trematodes; Agent: Dactylogyrus spp.; Gyrodactylus spp.; Type: Protozoan parasite; Syndrome: Occurs on body surface, fins or gills”

From Montana Water Center (2011):

“Whirling disease affects fish in the trout and salmon family. By damaging cartilage, whirling disease can kill young fish directly, or cause infected fish to swim in an uncontrolled whirling motion. This can make it impossible for them to escape predators or to effectively seek food.”

“Whirling disease is caused by a microscopic parasite called *Myxobolus cerebralis*. The parasite was introduced to the United States from Europe in the 1950s and has spread to many streams across the United States. The whirling disease parasite has been found in wild fish and fish hatcheries in 25 states.”

“Once established in a stream, the parasite cannot be eradicated, nor can its worm host, without significantly damaging the ecosystem. Whirling disease has no known human health effects.”

From CABI (2015a):

“Distribution [of whirling disease agent *M. cerebralis*] … USA: Arizona [Bartholomew and Reno 2002; Steinbach et al. 2009] … California [Yasutake and Wolf 1970] … Colorado [Barney et al. 1988; Walker and Nehring, 1995] … Connecticut [Hoffman et al. 1962] … Idaho [Hauck et al. 1988] … Maryland [Bartholomew and Reno 2002] … Michigan [Hnath 1970; Yoder 1972] … Montana [Vincent 1996] … Nebraska [Steinbach et al. 2009] … Nevada [Taylor et al. 1973; Yasutake and Wolf 1970] … New Hampshire [Hoffman 1990] … New Mexico [Hansen et al. 2002] … New York [Hoffman 1990] … Ohio [Tidd and Tubb 1970] … Oregon [Holt et al. 1987] … Pennsylvania [Hoffman et al. 1962] … Utah [Wilson 1991] … Vermont [Steinbach et al. 2009] … Virginia [Hoffman 1970] … Washington [Bartholomew and Reno 2002] … West Virginia [Meyers 1969] … Wyoming [Mitchum 1995]"

From Haenen et al. (2013):

"*Streptococcus iniae*, a Gram-positive bacterium, is a zoonotic pathogen in fresh water and marine fish, causing disease outbreaks in aquatic species [Agnew and Barnes 2007] and invasive disease in humans [Baiano and Barnes 2009]. This pathogen causes significant economic losses, particularly in the tilapia and hybrid striped bass aquaculture industries in the USA, Japan, Israel, South Africa, Australia, the Philippines, Taiwan, Bahrain and other countries."

From Soliman et al. (2008):

"*Oreochromis niloticus* is more resistant to the SVCV [spring viraemia of carp virus] than the susceptible hosts (Family Cyprinidae), but due to the several stress conditions which are facing the cultured fish in our culture pond systems, which lead to immunosuppression (the same role played by cortisone injected to the examined fish during the experimental infection), the *Oreochromis niloticus* can catch the infection with the virus, with little or, in some times, no specific clinical signs or post mortem lesions and may serve as a carrier to the virus."

Spring viraemia of carp (SVC) is an OIE-reportable disease.

Threat to humans

From Froese and Pauly (2015):

"Potential pest"

3 Impacts of Introductions

From Nico et al. (2015):

"Nile tilapia exert competition pressures on native fish and are known to prey on amphibians and juveniles of other fish species (Zambrano et al. 2006). However, Peterson et al. (2006) found little overlap in the diets of Nile tilapia and three native centrarchids (bluegill *Lepomis macrochirus*, redear sunfish *L. microlophus*, and largemouth bass *Micropterus salmoides*), with tilapia foraging at a lower trophic level (e.g., higher proportion of small benthic invertebrates and detritus) than native centrarchids (primarily consuming fishes and larger invertebrates). In Nevada and Arizona, the introduction of *O. niloticus* has resulted in the decline of endangered Moapa dace and Moapa white river springfish (Wise et al. 2007). Martin et al. (2010) found that Nile tilapia displaced native redspotted sunfish (*L. miniatus*) from preferred habitat in laboratory experiments, exposing the sunfish to greater predation pressure."

From CABI (2015b):

"Nile tilapia is well-suited for aquaculture because of its wide range of trophic and ecological adaptations, and its adaptive life history characteristics that enable it to occupy many different tropical and sub-tropical freshwater niches (Trewavas, 1983). These attributes have inherently predisposed it to be a successful invasive species, with established feral populations in most tropical and sub-tropical environments in which it has either been cultured or has otherwise gained access to (Welcomme, 1988; Pullin et al., 1997; Costa-Pierce, 2003; Canonico et al., 2005). However, predicting the areas where Nile tilapia will spread, once introduced to and area, can be difficult."

"Decisions on exotic fish introductions are usually based on a trade-off between socio-economic benefits and potential adverse ecological effects (Cowx, 1999). In Zambia, for example, aquaculture projects rearing Nile tilapia have been ardently promoted within the Zambezi River system, and the inevitable fish escapes from such facilities have led to the establishment of feral populations in river systems such as the Kafue River (Schwank, 1995) and tributaries of the Upper Kapombo River, and Nile tilapia will probably futher spread in the upper Zambezi River, where indigenous *Oreochromis* species such as *O. andersonii* and *O. macrochir* will be at risk of being outcompeted (Tweddle, 2010)."

"Tilapia introductions were often associated with severe environmental change, especially construction of reservoirs and large-scale irrigation projects. Many populations of tilapia are now so well established they are a permanent part of the fish community. Introduced tilapia often will develop large populations and male Nile tilapia will create nesting areas that will cover large areas of disturbed bottom sediments. The male's aggressive protection of nest territory may impact native nest builders."

From Figueredo and Giani (2005):

"To measure the effects of tilapia on the phytoplankton community and on water conditions of a large tropical reservoir in south-eastern Brazil (Furnas Reservoir), we performed two in situ experiments using three controls (no fish) and three tilapia enclosures (high fish density). … Fish presence increased nitrogen (N) and phosphorus (P) availability (ammonium … 70% mean increase … and total phosphorus … 270% mean increase) via excretion. Nutrient recycling by fish can thus be significant in the nutrient dynamics of the reservoir. The higher chlorophyll *a* concentration in the experimental fish tanks … was the result of a positive bottom-up effect on the phytoplankton community. … Because tilapia feed selectively on large algae (mainly cyanobacteria and diatoms), several small-sized or mucilaginous colonial chlorophyceans proliferated at the end of the experiments. Thus, the trophic cascade revealed strong influences on algal composition as well as on biomass. Tilapia can contribute to the eutrophication of a waterbody by both top-down and bottom-up forces. In particular, by supplying considerable amount of nutrients it promotes the increase of fast growing algae. Tilapia must be used cautiously in aquaculture to avoid unexpected environmental degradation."

From Gu et al. (2015):

"Nile tilapia (*Oreochromis niloticus*) is one of the most widespread invasive fish species, and this species has successfully established populations in the major rivers of Guangdong Province, China. Field surveys and manipulative experiments were conducted to assess the impacts of Nile tilapia on fisheries. We determined that the increase of Nile tilapia in these rivers not only affects the CPUE (catch-per-unit-per-effort) of the fish community and native fish species but also reduces the income of fishermen. In the manipulative experiments, we observed that the growth of native mud carp decreased in the presence of Nile tilapia. Our results suggest that the invasion of Nile tilapia negatively affected the fishery economy and native fish species, and suitable control measurements should be taken."

From Welcomme (1988):

"Widespread in fish ponds. Stunts and crossbreeds with other *Oreochromis* species."

4 Global Distribution

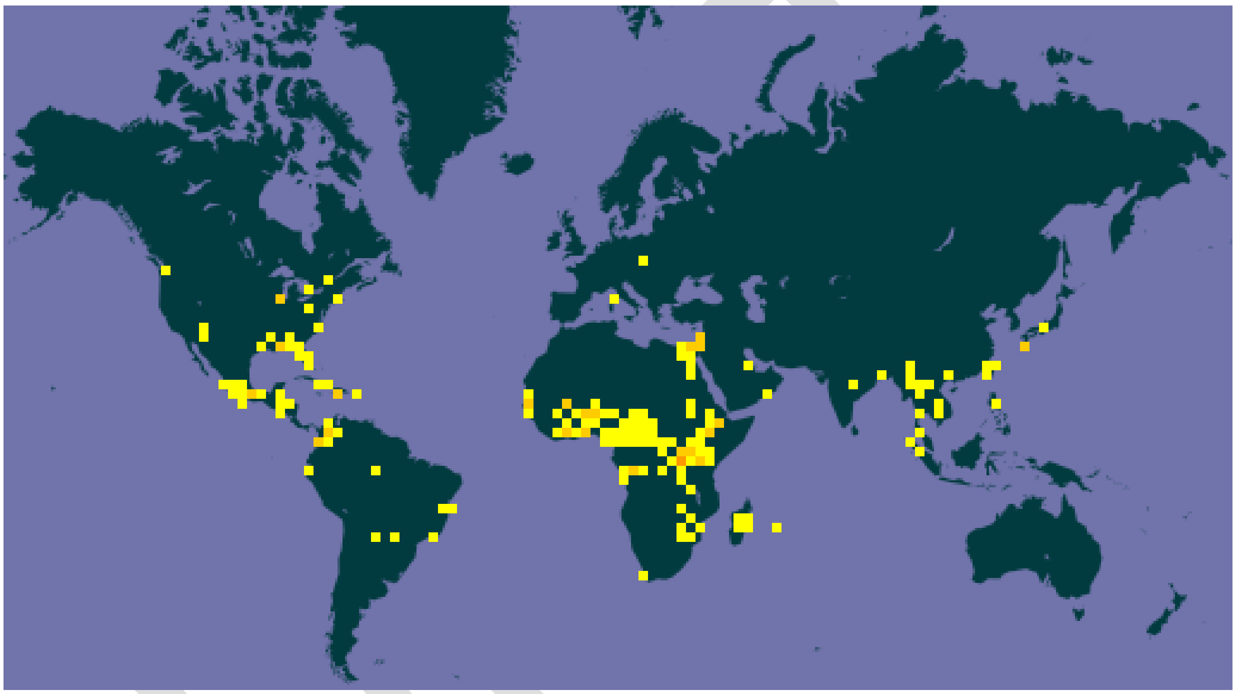

Figure 1. Known global distribution of *Oreochromis niloticus*. Map from GBIF (2015). Locations in the northern and western U.S., Poland, and Oman were omitted from climate matching (Sec. 6) because they did not represent known extant populations.

5 Distribution within the United States

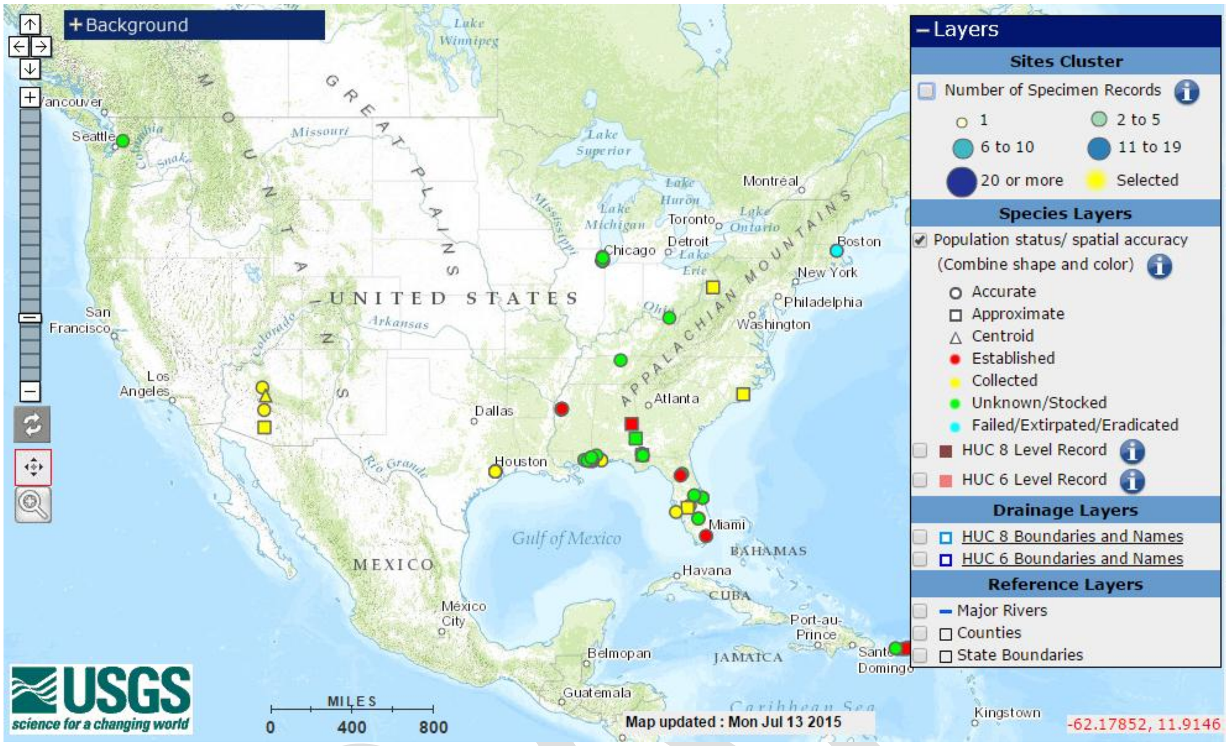

Figure 2. U.S. distribution of *Oreochromis niloticus*. Map from Nico et al. (2015).

6 Climate Match

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) is high in the Southeast and much of California. Medium match is found in the southern Midwest region, south Texas, and the Desert Southwest. Low match occurs in the Northeast and Mid-Atlantic regions, around the Great Lakes, the Plains states, Inner West, and Pacific Northwest. Climate 6 match indicates that the continental U.S. has a high climate match. The range for a high climate match is 0.103 and greater; Climate 6 score of *Oreochromis niloticus* is 0.220.

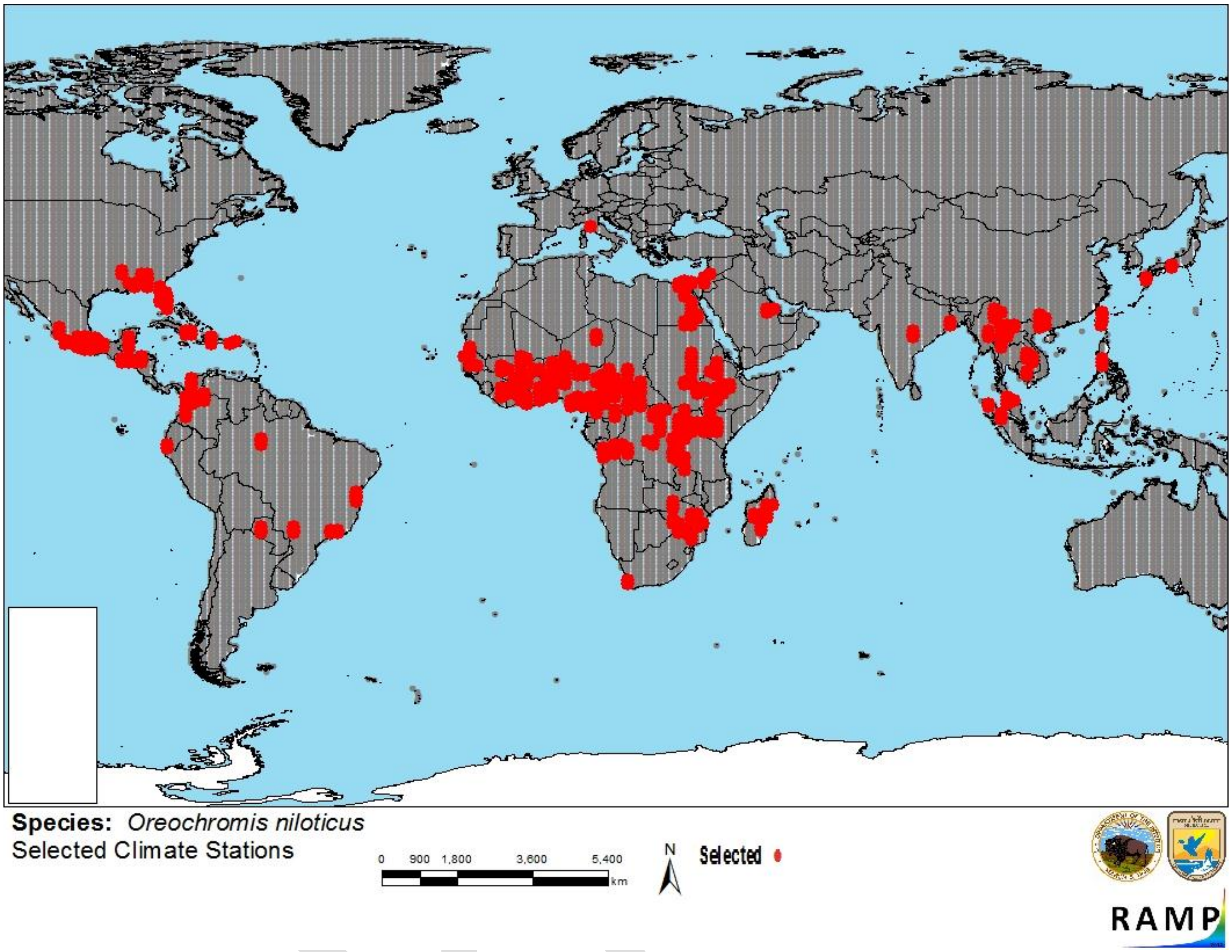

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Oreochromis niloticus* climate matching. Source locations from GBIF (2015) and Nico et al. (2015).

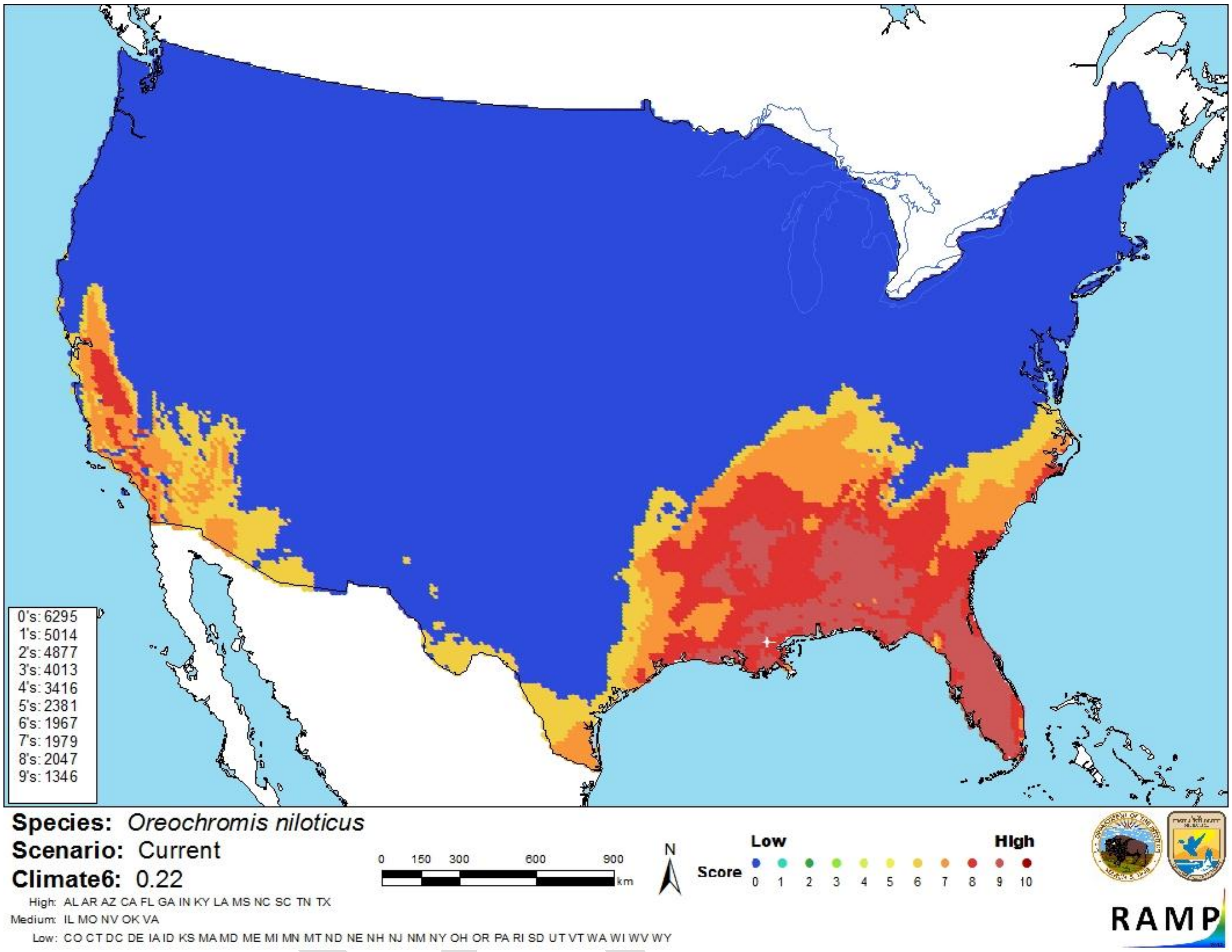

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Oreochromis niloticus* in the continental United States based on source locations reported by GBIF (2015) and Nico et al. (2015). 0= Lowest match, 10=Highest match. Counts of climate match scores are tabulated on the left.

7 Certainty of Assessment

Information on the biology, distribution, and impacts of *O. niloticus* is readily available. Negative impacts from introductions of this species are adequately documented in the scientific literature. No further information is needed to evaluate the negative impacts the species is having where introduced. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Continental United States

O. niloticus has been transported around the world because of its high value for fisheries and aquaculture. Climate match to the contiguous U.S. is high. The species has already established wild populations in Florida, Alabama, and Mississippi, with the climate match suggesting highest risk of further establishment in the Southeast and California. Impacts of *O. niloticus* in its introduced range include eutrophication of waterbodies through its influences on the plankton community, competition with native fishes, hybridization, and in some cases, reduced fishing success. Overall risk posed by this species is high.

Assessment Elements

- **History of Invasiveness (Sec. 3):** High
- **Climate Match (Sec.6):** High
- **Certainty of Assessment (Sec. 7):** High
- **Remarks/Important additional information** Host of numerous diseases and parasites, most notably whirling disease, streptococcosis, and possibly spring viraemia of carp.
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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